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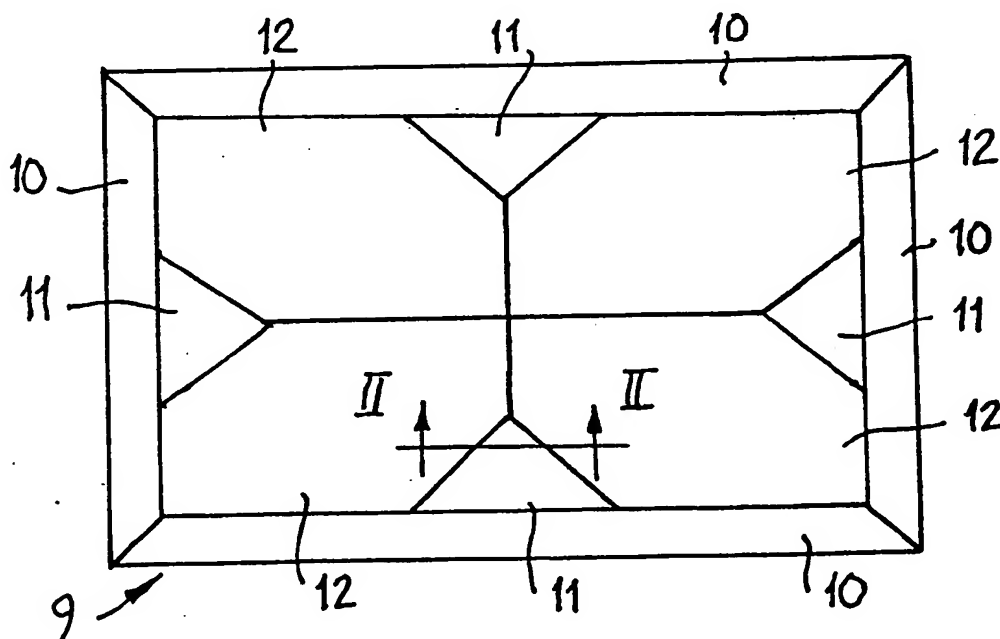
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(54) Title: **TILES, METHOD OF MANUFACTURING TILES FROM PLASTIC MATERIAL AND EQUIPMENT FOR FACILITATING SUCH MANUFACTURE**



(57) Abstract

A plastics tile (9) is made up of a plurality of discrete plastics pieces (10, 11, 12) which are shaped relative to each other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces. The pieces are joined together along said mutually abutting edges below the recesses to form a unitary tile.

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# TILES. METHOD OF MANUFACTURING TILES FROM PLASTIC MATERIAL AND EQUIPMENT FOR FACILITATING SUCH MANUFACTURE

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates to tiles, to a method of manufacturing tiles from plastics materials, and to equipment for facilitating such manufacture.

In particular, although not exclusively, the present invention is concerned with the manufacture of plastics floor tiles which have a predefined pattern of blocks with a wood grain appearance which resemble wooden parquet floors.

### 2. Discussion of Prior Art

One way of manufacturing such tiles, in the past, has been to pre-print each tile with a preset pattern of blocks. In this case every tile has exactly the same pattern of blocks and it is difficult to make the whole floor resemble a natural wooden block parquet floor because it is impossible to achieve a random effect. To overcome this monotony, one could produce a number of sets of tiles with each set of tiles being of the same pattern of blocks as all the other sets but with different wood grain effects for each set of tiles. Such approaches have been quite expensive to produce because of the different sets of artwork required to make each tile. Furthermore, it is impossible to achieve a totally random effect.

An object of the present invention is to provide a plastics tile which is made of a number of predetermined shaped pieces which are joined together to produce a unitary tile.

## 30 SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a plastics tile comprising a plurality of discrete plastics pieces which are shaped relative to each

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other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces, said pieces being joined together along said 5 mutually abutting edges below the recesses to form a unitary tile.

Preferably the upper regions of the peripheral edge of each piece that abuts another piece is provided with a chamfer to form V-shaped recesses extending down from the 10 top surface of the tile along the mutually abutting edges of the pieces, and the pieces are joined together through the full depth of the extent of the edges that contact adjoining pieces below the bottom of the recesses.

Preferably the joins are continuous joins, but they 15 could be joined at spots at spaced intervals along the edges between mutually abutting pieces.

In a preferred embodiment each piece comprises a top layer of translucent plastics material, a printed layer and a backing layer, and the pieces are joined together through 20 the thickness of the backing layer.

According to a further aspect of the invention a method of manufacturing a tile comprises the steps of cutting a plurality of complementary shaped pieces from a sheet of plastics material, the pieces having recessed edges in upper 25 regions thereof, assembling the pieces to form the precursor of a tile of the required shape with abutting edges below said recesses between each pair of adjacent pieces, and effecting a join at said edges below the bottom of each said recess to form a unitary tile.

30 Conveniently at least two sets of at least two pieces cut from sheet stock are used to assemble each unitary tile, the pieces of each set being shaped so that they can be interengaged in a plurality of different ways to give the

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same shaped unitary tile whereby to provide a reduced probability of producing two tiles of identical appearance from sheet stock of standard appearance.

Preferably the join is effected by welding using a tool  
5 that localises the heating effect to the mutually abutting edges below the bottom of each recess. The preferred form of heating is dielectric heating, but other forms of joining such as ultrasonic welding, or heat bonding using heated platens could be used. If desired forms of joining can be  
10 used that do not rely on heating, for example adhesive bonding or solvent bonding may be used.

The method of manufacture is conveniently conducted using a dielectric heating device in which the shaped pieces are assembled in a rimmed base member of the device and are  
15 conjoined by welding along mutually abutting edges between the base member and an electrode of the heating device, which electrode has projections entering recesses formed along said mutually abutting edges.

#### BRIEF DESCRIPTION OF DRAWING

20 The present invention will now be described by way of example and with reference to the accompanying drawing, in which:

Figure 1 is a plan view of a single tile constructed in accordance with the present invention, made of a plurality  
25 of pieces which are joined together,

Figure 2 is a cross-sectional elevation, on an enlarged scale, through part of the tile taken along line II-II of Figure 1, showing, schematically, the join between two adjacent pieces,

30 Figure 3 shows a dielectric heating device for making the tile of Figure 1, and

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Figure 4 shows, in greater detail, the design of part of one electrode of the device of Figure 3.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, each tile 9 is made of three sets of pieces 10, 11 and 12. Each set of pieces (10, 11 or 12) comprises four identically shaped pieces. All the pieces for each set are cut from a large sheet of plastics material approximately 1 metre wide.

The sheet of material comprises laminations consisting of a top translucent PVC wear layer 14 approximately 1.0 mm thick which is bonded to a thin PVC film 15 which is printed with a woodgrain effect with a coloured background. The film 15 is bonded to a white PVC background layer 16 which has the effect of lightening the coloured background of the film 15. The white layer 16 is bonded to a black PVC backing layer 17. The bonding of the layers is achieved by laying up the layers 14, 15, 16 and 17 and heat bonding them under pressure to produce a laminated sheet that is about 2.5 mm thick.

Although the pieces making up each set of pieces 10, 11 or 12 are of identical size and shape and are cut from a large sheet of the material, the wood grain effect varies from one piece to another, despite the fact that the wood grain effect pattern is repeated on the large sheet from which the pieces are cut. Furthermore, because the pieces of each set are identical and symmetrical, even if, against the odds, the pattern were the same on a number of identically shaped pieces of any set, it is highly unlikely that one would produce two tiles with exactly the same woodgrain effects on all the pieces of two or more tiles. Accordingly, by assembling the sets of pieces 10, 11 and 12 to make a tile it is possible to achieve a totally random effect.

As described, three sets of four pieces each, are used



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but other arrangements are possible from a minimum of two sets of at least two pieces per set.

Each of the pieces is cut from the larger sheet of material using a tool which is described in our International Patent Application No. PCT/GB92/02115 published as WO 93/. Each piece has a chamfered edge 20 in its upper region in which the chamfer is approximately 45° and extends to a depth not deeper than the film 15.

The four pieces of each of the three sets 10, 11 and 12 are assembled by abutting the edges of the pieces over lower regions thereof to make a precursor tile measuring 300 x 300 mm, and one or more of such tile precursors are held in a dielectric heating welding machine shown schematically in Figure 3 which consists of a metal base 18 having rims 18a and a metal top member 19. The top member 19 has projections 21 which define a pattern of shapes identical to the pieces of the sets 10, 11 and 12 and effectively defines weld lines corresponding to the abutting edges between the pieces 10, 11 and 12. The base 18 and top member 19 effectively constitute the electrodes of a radio frequency dielectric heating unit.

The power supply to the electrodes 18 and 19 is taken from a 15Kw, 29Ka power supply unit running at a frequency of 27MHz and automatically adjusts the voltage level to maintain correct dielectric heating of the layers to be welded. In order to reduce problems of localised overheating in the welds due to presence of moisture, the base 18 and top member 19 are preheated to a temperature between 40°C and 100°C by means of water-heated heat exchangers (not shown) in contact with the base 18 and the top member 19. Heating the base 18 and top member 19 also has a beneficial effect by imparting some heat into the region to be welded but not sufficient heat to damage the wear layer 14 of the tile.

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Referring to Figure 4, the projections 21 on the top electrode 19 are of a smaller included angle than that defined by the two chamfered edges 20 of the abutting pieces (which is about 136°).

5 To avoid thermal damage to the exposed upper surface of the wear layer 14 during the welding, the semi-angle of the recess created by the edges 20 should be greater than the semi-angle of the projection. A semi-angle of the recess exceeding 45° (e.g. 68°) and a semi-angle of the projection  
10 of not more than 45° is preferred.

By providing the top electrode 19 with a sharp point at the tip of the projections 20, the shortest path for the electrical field generated during dielectric welding will be vertically through the tile between the member 19 and the  
15 base 18. This ensures that only a minimum amount of the tile is heated when the pieces are welded together and avoids disfiguring damage to the exposed upper surface of the tile. This lack of damage is made possible by the fact that the pieces are chamfered or recessed downwardly from  
20 the top surface.

The base member 18 can have two adjustable rims 18a whereby after laying the twelve pieces 10, 11 and 12 onto the base member in the required array (e.g. as shown in Figure 1) the rims 18a are moved to close the pieces  
25 together to form the rectangular configuration shown with confronting edges in lower regions of the pieces in abutment.

The electrode 19 is lowered into contact with the assembled pieces and an electrical current at a frequency of  
30 27 MHz is applied through the base 18 and electrode 19 to generate dielectric heating and melt and thereby fuse, or weld, only the lower regions (that is to say the layers 15, 16 and 17) to form a unitary tile. In this way all of the pieces are butt welded together along welded joints

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extending around the various pieces.

Whilst it is preferred to effect the welding as a "single-shot" process using radio frequency energy sufficiently powerful to weld all the seams simultaneously, it is to be understood that other techniques can be used. We have used a "spot-welding" technique where electromagnetic dielectric heating was used to effect "spot" welds at closely spaced intervals along each line of abutting edges, instead of producing a continuous weld, however it has been found that after the tiles had been laid in place on a floor for some time, the location of the spot welds became manifest as slight blemishes in the unitary tile.

The welding can also be carried out from the underside of the tile, that is to say from the backing layer 17 side of the tile. In this case the pieces are laid on the base of the jig with the translucent layer 14 facing the base and the top member 19 is brought down against the backing layer 17 to melt and fuse the abutting edges of the layers 15, 16 and 17. In this case the base 18 of the jig would have protrusions (similar in shape and size to the protrusions 20) that fit into the "V" shape defined by the chamfered edges of the pieces 10, 11 and 12 as shown in Figure 4. It is much more difficult to assemble the pieces on a base plate 18 which has projections corresponding to the seam lines because each piece has to locate perfectly in the recesses formed by the raised projections. However there may be instances where it is advantageous to concentrate the electric field on the back surface of the tile.

An essential requirement of layers to be welded together in accordance with the dielectric heating embodiment of the present invention is that they are susceptible to absorption of electromagnetic energy by the dielectric effect. Almost all solid non-conductive plastics will absorb energy by dielectric heating to a certain

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extent. Some plastics such as polyethylene and polystyrene for example have relatively low dielectric heat absorption characteristics; these are often said to have a low "loss factor". On the other hand PVC has a relatively high "loss factor" and will absorb electromagnetic energy by the dielectric effect. Therefore if one wishes to use a low "loss-factor" plastic as the backing layer one will need to modify its characteristics to increase its "loss-factor" by the addition or alloying of particles or other polymers.

10 In the above embodiment the method of joining is achieved using a dielectric heating method. Other forms of welding such as, for example, ultrasonic welding, or heat bonding using heated platens which are pressed into contact with the lower layers of the tile could be used for  
15 materials which will not absorb energy by dielectric heating. Indeed the joining may be done by adhesive bonding or by solvent bonding, although this is thought to be slightly more messy than the preferred welding methods.

In order to obtain an attractive tile it has been found  
20 to be essential to effect bonding or joining only in the lower regions of each tile, and not in the translucent layer 14. The chamfered edges of the pieces give the appearance of the wood grain extending through the entire depth of the translucent layer. In addition, by only joining those layers  
25 which are normally out of sight, one can use different thermoplastics at the surface of the tile which would be otherwise non-weldable using dielectric heating methods or otherwise unsuitable for joining or bonding.

Although the present invention is eminently suitable  
30 for making parquet type floor tiles with woodgrain patterning of the shapes shown in Figure 1, the invention may be used to join assembled pieces of any shape and colour to make unitary tiles.

In the embodiments described above, the pieces have an

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angled chamfer. It is to be understood that the top edge of each piece may be cut back with a vertical, rounded or other shaped edge which forms a small groove or recess in the top face of the tile at each join between pieces.

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CLAIMS

1. A plastics tile comprising a plurality of discrete plastics pieces which are shaped relative to each other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces, said pieces being joined together along said mutually abutting edges below the recesses to form a unitary tile.

2. A tile according to claim 1, wherein the upper regions of the peripheral edge of each piece that abuts another piece is provided with a chamfer to form V-shaped recesses extending down from the top surface of the tile along the mutually abutting edges of the pieces, and the pieces are joined together through the full depth of the extent of the edges that contact adjoining pieces below the bottom of the recesses.

3. A tile according to claim 2, wherein said joining together is by continuous joins.

4. A tile according to claim 2, wherein the pieces are joined together by spot joining the pieces at spaced intervals along the edges between mutually abutting pieces.

5. A tile according to claim 1, wherein each piece comprises a top layer of translucent plastics material, a printed layer and a backing layer, and the pieces are joined together only through the thickness of the backing layer.

6. A tile according to claim 5, wherein there is a coloured layer between the backing layer and the printed layer.

7. A method of manufacturing a tile constructed in accordance with claim 1, comprising the steps of cutting a

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plurality of complementary shaped pieces from a sheet of plastics material, the pieces having recessed edges in upper regions thereof, assembling the pieces to form the precursor of a tile of the required shape with abutting edges below  
5 said recesses between each pair of adjacent pieces, and effecting a join at said edges below the bottom of each said recess to form a unitary tile.

8. A method according to claim 7, wherein the join is effected by welding.

10 9. A method according to claim 8, wherein the welding step is carried out by dielectric heating of the pieces in the vicinity of the join.

10. A method according to claim 7, in which at least two sets of at least two pieces cut from sheet stock are  
15 used to assemble each unitary tile, the pieces of each set being shaped so that they can be interengaged in a plurality of different ways to give the same shaped unitary tile whereby to provide a reduced probability of producing two tiles of identical appearance from sheet stock of standard  
20 appearance.

11. In a method according to claim 1, the use of a welding jig in which the shaped pieces are assembled in a rimmed base member of the jig and are conjoined by welding along mutually abutting edges through dielectric heating of  
25 the pieces between the base member and a top electrode, which top electrode has projections entering recesses formed along said mutually abutting edges.

12. A method according to claim 11, in which said recesses have a semi-angle greater than 45° and said  
30 projection has a semi-angle of not more than 45°.

13. In a method according to claim 11, the use of a base member with at least one adjustable rim to close edges

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of the pieces together prior to welding.

14. A method according to claim 8, wherein the join is effected by ultrasonic welding.

15. A method according to claim 7, wherein the join is effected by adhesive bonding.

16. A method according to claim 7, wherein the join is effected by solvent bonding.



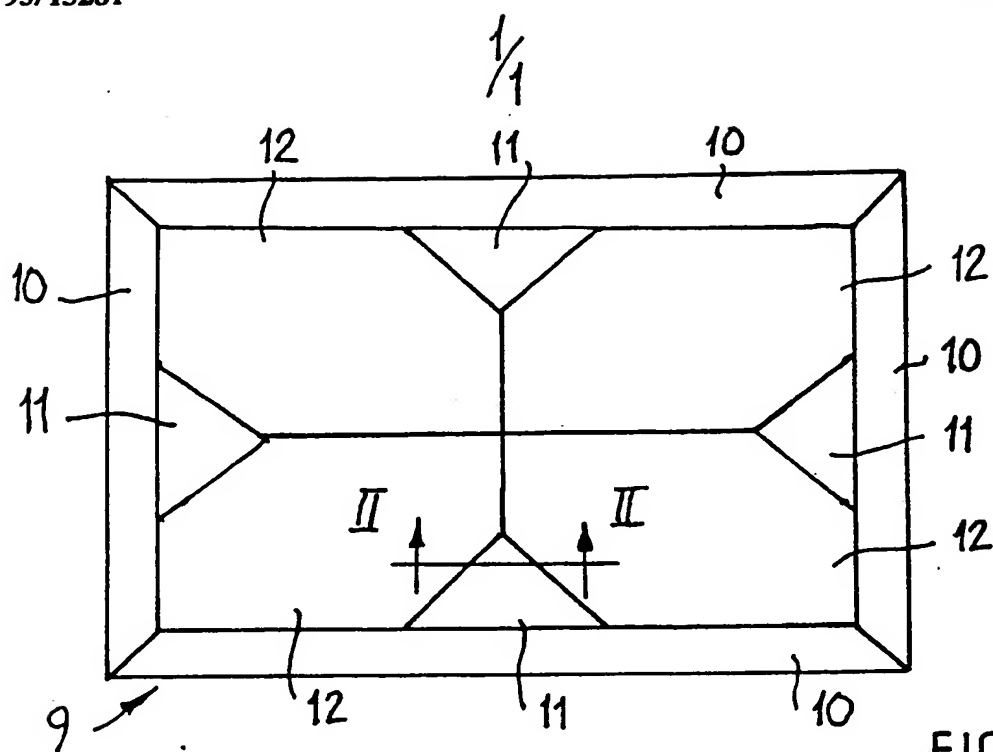


FIG. 1

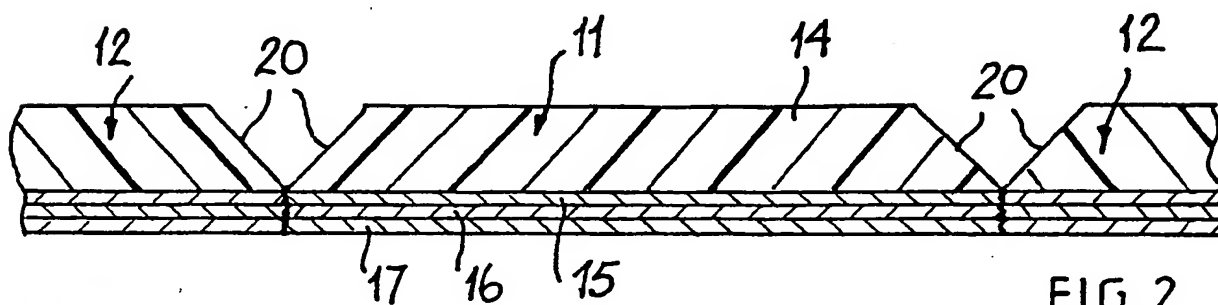


FIG. 2

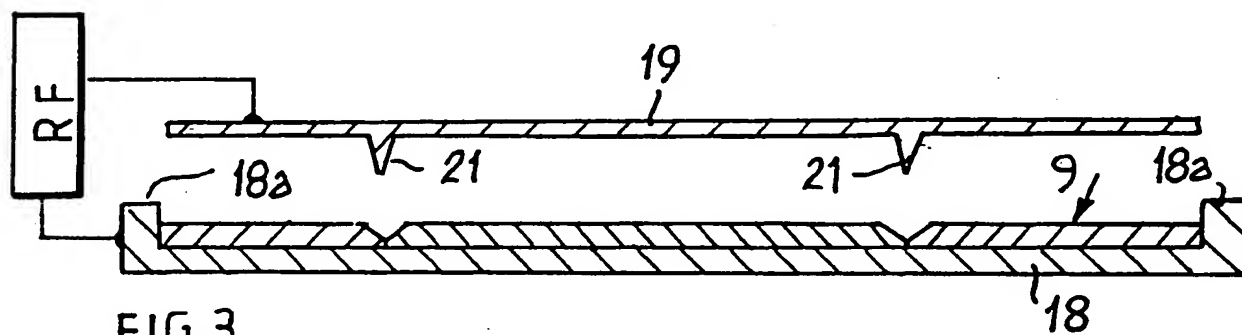


FIG. 3

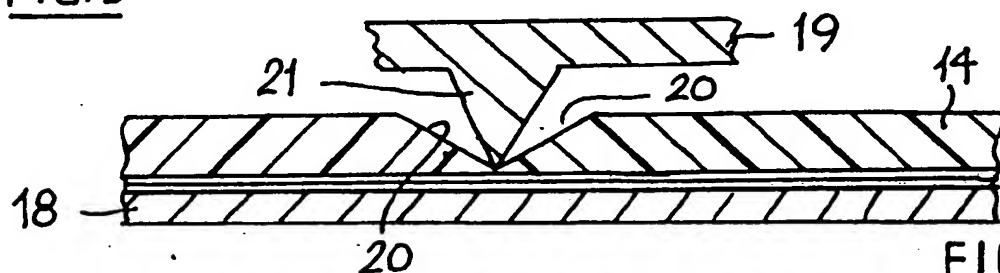


FIG. 4

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 92/02361

## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B29C, B44C, E04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## WPI, CLAIMS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4828896 (L. FANTI), 9 May 1989 (09.05.89), column 2, line 1 - line 18, claims 1-6  --	1-6
A	US, A, 3647587 (J.C. MACDONALD), 7 March 1972 (07.03.72), column 1, line 45 - line 50; column 2, line 50 - line 55, claim 1  -- -----	1-6



Further documents are listed in the continuation of Box C.



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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

26/02/93

International application No.

PCT/GB 92/02361

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4828896	09/05/89	EP-A- 0273597 GB-A,B- 2198165 JP-A- 63149137	06/07/88 08/06/88 21/06/88
US-A- 3647587	07/03/72	NONE	

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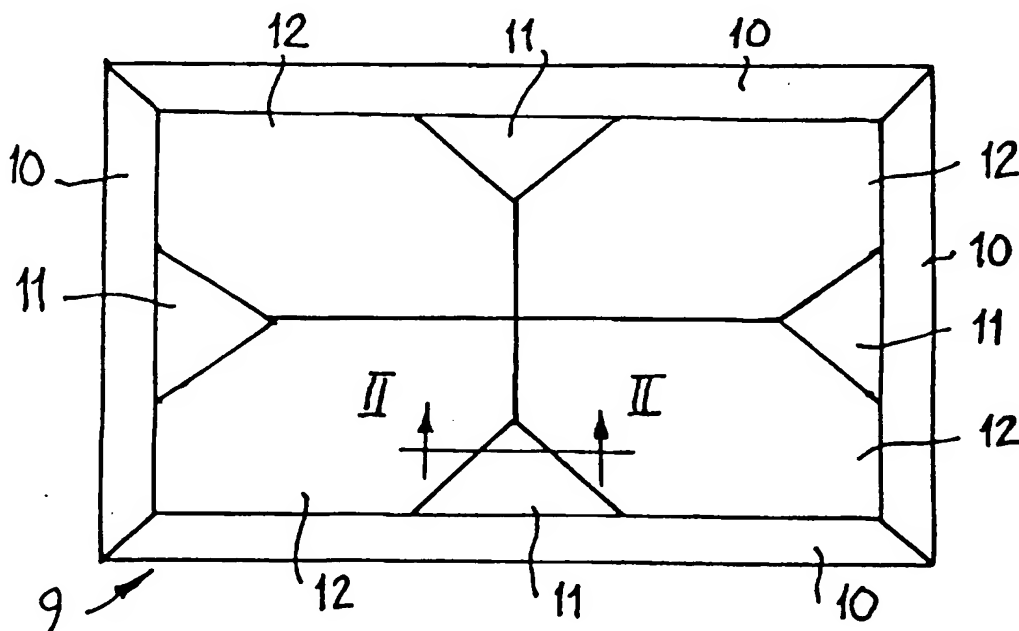
(74) Agent: NEWBY, John, Ross; J.Y. &amp; G.W. Johnson, Furnival House, 14-18 High Holborn, London WC1V 6DE (GB).

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(54) Title: TILES, A METHOD OF MANUFACTURING TILES FROM PLASTIC MATERIAL AND EQUIPMENT FOR FACILITATING SUCH MANUFACTURE



## (57) Abstract

A plastics tile (9) is made up of a plurality of discrete plastics pieces (10, 11, 12) which are shaped relative to each other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces. The pieces are joined together along said mutually abutting edges below the recesses to form a unitary tile.

\* (Referred to in PCT Gazette No. 15/1994, Section II)

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TILES, A METHOD OF MANUFACTURING TILES FROM PLASTIC MATERIAL AND EQUIPMENT FOR FACILITATING SUCH MANUFACTURE

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to tiles, to a method of  
5 manufacturing tiles from plastics materials, and to  
equipment for facilitating such manufacture.

In particular, although not exclusively, the present  
invention is concerned with the manufacture of plastics  
floor tiles which have a predefined pattern of blocks with  
10 a wood grain appearance which resemble wooden parquet  
floors.

#### 2. Discussion of Prior Art

One way of manufacturing such tiles, in the past, has  
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15 In this case every tile has exactly the same pattern of  
blocks and it is difficult to make the whole floor resemble  
a natural wooden block parquet floor because it is  
impossible to achieve a random effect. To overcome this  
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the other sets but with different wood grain effects for  
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expensive to produce because of the different sets of  
artwork required to make each tile. Furthermore, it is  
25 impossible to achieve a totally random effect.

An object of the present invention is to provide a  
plastics tile which is made of a number of predetermined  
shaped pieces which are joined together to produce a unitary  
tile.

### 30 SUMMARY OF THE INVENTION

According to one aspect of the present invention there  
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other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces, said pieces being joined together along said mutually abutting edges below the recesses to form a unitary tile.

Preferably the upper regions of the peripheral edge of each piece that abuts another piece is provided with a chamfer to form V-shaped recesses extending down from the top surface of the tile along the mutually abutting edges of the pieces, and the pieces are joined together through the full depth of the extent of the edges that contact adjoining pieces below the bottom of the recesses.

Preferably the joins are continuous joins, but they could be joined at spots at spaced intervals along the edges between mutually abutting pieces.

In a preferred embodiment each piece comprises a top layer of translucent plastics material, a printed layer and a backing layer, and the pieces are joined together through the thickness of the backing layer.

According to a further aspect of the invention a method of manufacturing a tile comprises the steps of cutting a plurality of complementary shaped pieces from a sheet of plastics material, the pieces having recessed edges in upper regions thereof, assembling the pieces to form the precursor of a tile of the required shape with abutting edges below said recesses between each pair of adjacent pieces, and effecting a join at said edges below the bottom of each said recess to form a unitary tile.

Conveniently at least two sets of at least two pieces cut from sheet stock are used to assemble each unitary tile, the pieces of each set being shaped so that they can be interengaged in a plurality of different ways to give the



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same shaped unitary tile whereby to provide a reduced probability of producing two tiles of identical appearance from sheet stock of standard appearance.

Preferably the join is effected by welding using a tool  
5 that localises the heating effect to the mutually abutting edges below the bottom of each recess. The preferred form of heating is dielectric heating, but other forms of joining such as ultrasonic welding, or heat bonding using heated platens could be used. If desired forms of joining can be  
10 used that do not rely on heating, for example adhesive bonding or solvent bonding may be used.

The method of manufacture is conveniently conducted using a dielectric heating device in which the shaped pieces are assembled in a rimmed base member of the device and are  
15 conjoined by welding along mutually abutting edges between the base member and an electrode of the heating device, which electrode has projections entering recesses formed along said mutually abutting edges.

#### BRIEF DESCRIPTION OF DRAWING

20 The present invention will now be described by way of example and with reference to the accompanying drawing, in which:

Figure 1 is a plan view of a single tile constructed in accordance with the present invention, made of a plurality  
25 of pieces which are joined together,

Figure 2 is a cross-sectional elevation, on an enlarged scale, through part of the tile taken along line II-II of Figure 1, showing, schematically, the join between two adjacent pieces,

30 Figure 3 shows a dielectric heating device for making the tile of Figure 1, and

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Figure 4 shows, in greater detail, the design of part of one electrode of the device of Figure 3.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, each tile 9 is made of three sets of pieces 10, 11 and 12. Each set of pieces (10, 11 or 12) comprises four identically shaped pieces. All the pieces for each set are cut from a large sheet of plastics material approximately 1 metre wide.

The sheet of material comprises laminations consisting of a top translucent PVC wear layer 14 approximately 1.0 mm thick which is bonded to a thin PVC film 15 which is printed with a woodgrain effect with a coloured background. The film 15 is bonded to a white PVC background layer 16 which has the effect of lightening the coloured background of the film 15. The white layer 16 is bonded to a black PVC backing layer 17. The bonding of the layers is achieved by laying up the layers 14, 15, 16 and 17 and heat bonding them under pressure to produce a laminated sheet that is about 2.5 mm thick.

Although the pieces making up each set of pieces 10, 11 or 12 are of identical size and shape and are cut from a large sheet of the material, the wood grain effect varies from one piece to another, despite the fact that the wood grain effect pattern is repeated on the large sheet from which the pieces are cut. Furthermore, because the pieces of each set are identical and symmetrical, even if, against the odds, the pattern were the same on a number of identically shaped pieces of any set, it is highly unlikely that one would produce two tiles with exactly the same woodgrain effects on all the pieces of two or more tiles. Accordingly, by assembling the sets of pieces 10, 11 and 12 to make a tile it is possible to achieve a totally random effect.

As described, three sets of four pieces each, are used

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but other arrangements are possible from a minimum of two sets of at least two pieces per set.

Each of the pieces is cut from the larger sheet of material using a tool which is described in our  
5 International Patent Application No. PCT/GB92/02115 published as WO 93/ . Each piece has a chamfered edge 20 in its upper region in which the chamfer is approximately 45° and extends to a depth not deeper than the film 15.

The four pieces of each of the three sets 10, 11 and 12  
10 are assembled by abutting the edges of the pieces over lower regions thereof to make a precursor tile measuring 300 x 300 mm, and one or more of such tile precursors are held in a dielectric heating welding machine shown schematically in Figure 3 which consists of a metal base 18 having rims 18a  
15 and a metal top member 19. The top member 19 has projections 21 which define a pattern of shapes identical to the pieces of the sets 10, 11 and 12 and effectively defines weld lines corresponding to the abutting edges between the pieces 10, 11 and 12. The base 18 and top member 19  
20 effectively constitute the electrodes of a radio frequency dielectric heating unit.

The power supply to the electrodes 18 and 19 is taken from a 15Kw, 29Ka power supply unit running at a frequency of 27MHz and automatically adjusts the voltage level to  
25 maintain correct dielectric heating of the layers to be welded. In order to reduce problems of localised overheating in the welds due to presence of moisture, the base 18 and top member 19 are preheated to a temperature between 40°C and 100°C by means of water-heated heat exchangers (not  
30 shown) in contact with the base 18 and the top member 19. Heating the base 18 and top member 19 also has a beneficial effect by imparting some heat into the region to be welded but not sufficient heat to damage the wear layer 14 of the tile.

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Referring to Figure 4, the projections 21 on the top electrode 19 are of a smaller included angle than that defined by the two chamfered edges 20 of the abutting pieces (which is about 136').

5 To avoid thermal damage to the exposed upper surface of the wear layer 14 during the welding, the semi-angle of the recess created by the edges 20 should be greater than the semi-angle of the projection. A semi-angle of the recess exceeding 45' (e.g. 68') and a semi-angle of the projection  
10 of not more than 45' is preferred.

By providing the top electrode 19 with a sharp point at the tip of the projections 20, the shortest path for the electrical field generated during dielectric welding will be vertically through the tile between the member 19 and the  
15 base 18. This ensures that only a minimum amount of the tile is heated when the pieces are welded together and avoids disfiguring damage to the exposed upper surface of the tile. This lack of damage is made possible by the fact that the pieces are chamfered or recessed downwardly from  
20 the top surface.

The base member 18 can have two adjustable rims 18a whereby after laying the twelve pieces 10, 11 and 12 onto the base member in the required array (e.g. as shown in Figure 1) the rims 18a are moved to close the pieces  
25 together to form the rectangular configuration shown with confronting edges in lower regions of the pieces in abutment.

The electrode 19 is lowered into contact with the assembled pieces and an electrical current at a frequency of  
30 27 MHz is applied through the base 18 and electrode 19 to generate dielectric heating and melt and thereby fuse, or weld, only the lower regions (that is to say the layers 15, 16 and 17) to form a unitary tile. In this way all of the pieces are butt welded together along welded joints

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extending around the various pieces.

Whilst it is preferred to effect the welding as a "single-shot" process using radio frequency energy sufficiently powerful to weld all the seams simultaneously, 5 it is to be understood that other techniques can be used. We have used a "spot-welding" technique where electromagnetic dielectric heating was used to effect "spot" welds at closely spaced intervals along each line of abutting edges, instead of producing a continuous weld, 10 however it has been found that after the tiles had been laid in place on a floor for some time, the location of the spot welds became manifest as slight blemishes in the unitary tile.

The welding can also be carried out from the underside 15 of the tile, that is to say from the backing layer 17 side of the tile. In this case the pieces are laid on the base of the jig with the translucent layer 14 facing the base and the top member 19 is brought down against the backing layer 17 to melt and fuse the abutting edges of the layers 15, 16 20 and 17. In this case the base 18 of the jig would have protrusions (similar in shape and size to the protrusions 20) that fit into the "V" shape defined by the chamfered edges of the pieces 10, 11 and 12 as shown in Figure 4. It is much more difficult to assemble the pieces on a base 25 plate 18 which has projections corresponding to the seam lines because each piece has to locate perfectly in the recesses formed by the raised projections. However there may be instances where it is advantageous to concentrate the electric field on the back surface of the tile.

30 An essential requirement of layers to be welded together in accordance with the dielectric heating embodiment of the present invention is that they are susceptible to absorption of electromagnetic energy by the dielectric effect. Almost all solid non-conductive plastics 35 will absorb energy by dielectric heating to a certain

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extent. Some plastics such as polyethylene and polystyrene for example have relatively low dielectric heat absorption characteristics; these are often said to have a low "loss factor". On the other hand PVC has a relatively high "loss factor" and will absorb electromagnetic energy by the dielectric effect. Therefore if one wishes to use a low "loss-factor" plastic as the backing layer one will need to modify its characteristics to increase its "loss-factor" by the addition or alloying of particles or other polymers.

10 In the above embodiment the method of joining is achieved using a dielectric heating method. Other forms of welding such as, for example, ultrasonic welding, or heat bonding using heated platens which are pressed into contact with the lower layers of the tile could be used for 15 materials which will not absorb energy by dielectric heating. Indeed the joining may be done by adhesive bonding or by solvent bonding, although this is thought to be slightly more messy than the preferred welding methods.

In order to obtain an attractive tile it has been found 20 to be essential to effect bonding or joining only in the lower regions of each tile, and not in the translucent layer 14. The chamfered edges of the pieces give the appearance of the wood grain extending through the entire depth of the translucent layer. In addition, by only joining those layers 25 which are normally out of sight, one can use different thermoplastics at the surface of the tile which would be otherwise non-weldable using dielectric heating methods or otherwise unsuitable for joining or bonding.

Although the present invention is eminently suitable 30 for making parquet type floor tiles with woodgrain patterning of the shapes shown in Figure 1, the invention may be used to join assembled pieces of any shape and colour to make unitary tiles.

In the embodiments described above, the pieces have an

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angled chamfer. It is to be understood that the top edge of each piece may be cut back with a vertical, rounded or other shaped edge which forms a small groove or recess in the top face of the tile at each join between pieces.

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CLAIMS

1. A plastics tile comprising a plurality of discrete plastics pieces which are shaped relative to each other and assembled together to abut edge to edge in lower regions of the pieces and form a recess above each mutually abutting edge of abutting pieces in upper regions of the pieces, said pieces being joined together along said mutually abutting edges below the recesses to form a unitary tile.

2. A tile according to claim 1, wherein the upper regions of the peripheral edge of each piece that abuts another piece is provided with a chamfer to form V-shaped recesses extending down from the top surface of the tile along the mutually abutting edges of the pieces, and the pieces are joined together through the full depth of the extent of the edges that contact adjoining pieces below the bottom of the recesses.

3. A tile according to claim 2, wherein said joining together is by continuous joins.

4. A tile according to claim 2, wherein the pieces are joined together by spot joining the pieces at spaced intervals along the edges between mutually abutting pieces.

5. A tile according to claim 1, wherein each piece comprises a top layer of translucent plastics material, a printed layer and a backing layer, and the pieces are joined together only through the thickness of the backing layer.

6. A tile according to claim 5, wherein there is a coloured layer between the backing layer and the printed layer.

7. A method of manufacturing a tile constructed in accordance with claim 1, comprising the steps of cutting a



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plurality of complementary shaped pieces from a sheet of plastics material, the pieces having recessed edges in upper regions thereof, assembling the pieces to form the precursor of a tile of the required shape with abutting edges below  
5 said recesses between each pair of adjacent pieces, and effecting a join at said edges below the bottom of each said recess to form a unitary tile.

8. A method according to claim 7, wherein the join is effected by welding.

10 9. A method according to claim 8, wherein the welding step is carried out by dielectric heating of the pieces in the vicinity of the join.

10. A method according to claim 7, in which at least two sets of at least two pieces cut from sheet stock are  
15 used to assemble each unitary tile, the pieces of each set being shaped so that they can be interengaged in a plurality of different ways to give the same shaped unitary tile whereby to provide a reduced probability of producing two tiles of identical appearance from sheet stock of standard  
20 appearance.

11. In a method according to claim 1, the use of a welding jig in which the shaped pieces are assembled in a rimmed base member of the jig and are conjoined by welding along mutually abutting edges through dielectric heating of  
25 the pieces between the base member and a top electrode, which top electrode has projections entering recesses formed along said mutually abutting edges.

12. A method according to claim 11, in which said recesses have a semi-angle greater than 45° and said  
30 projection has a semi-angle of not more than 45°.

13. In a method according to claim 11, the use of a base member with at least one adjustable rim to close edges

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of the pieces together prior to welding.

14. A method according to claim 8, wherein the join is effected by ultrasonic welding.

15. A method according to claim 7, wherein the join is effected by adhesive bonding.

16. A method according to claim 7, wherein the join is effected by solvent bonding.

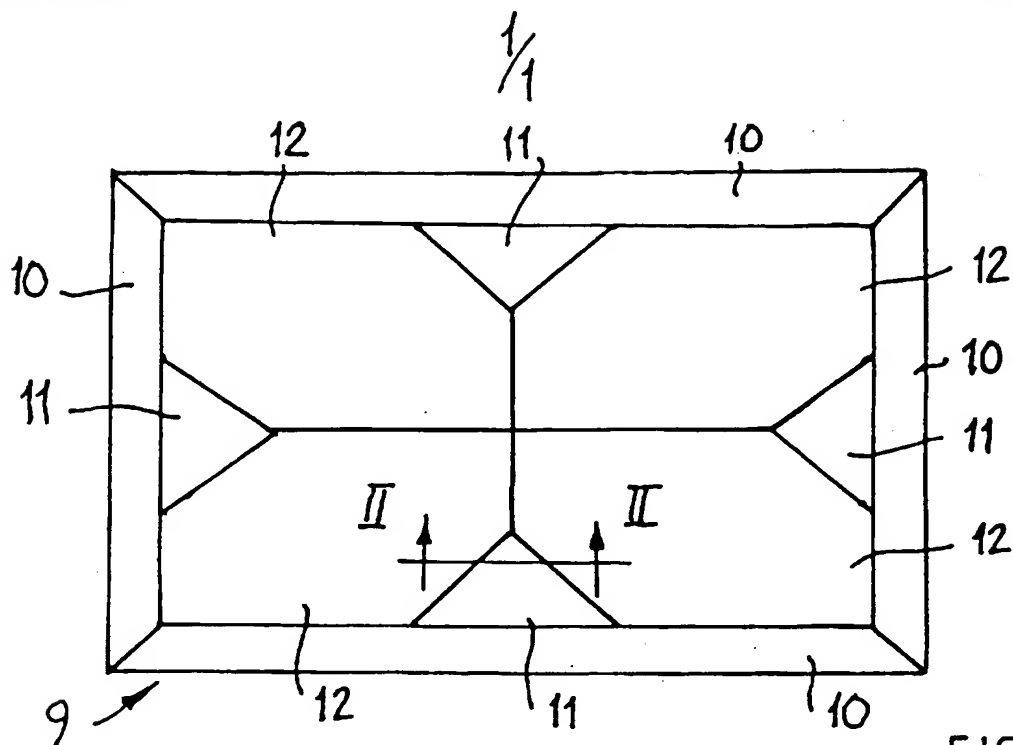


FIG. 1

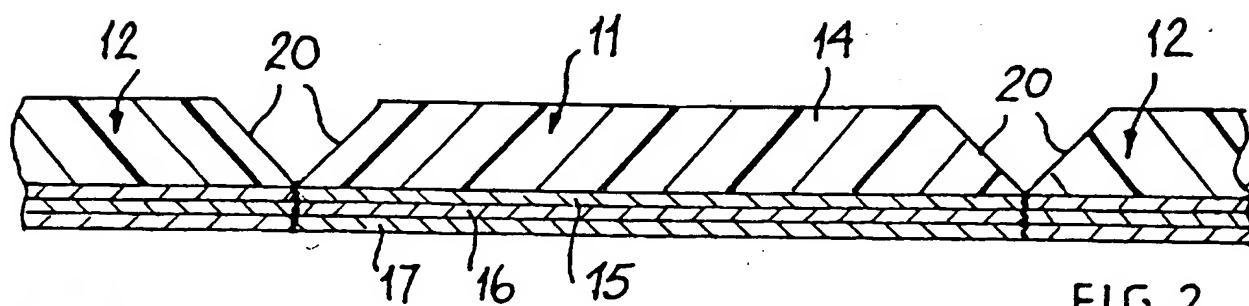


FIG. 2

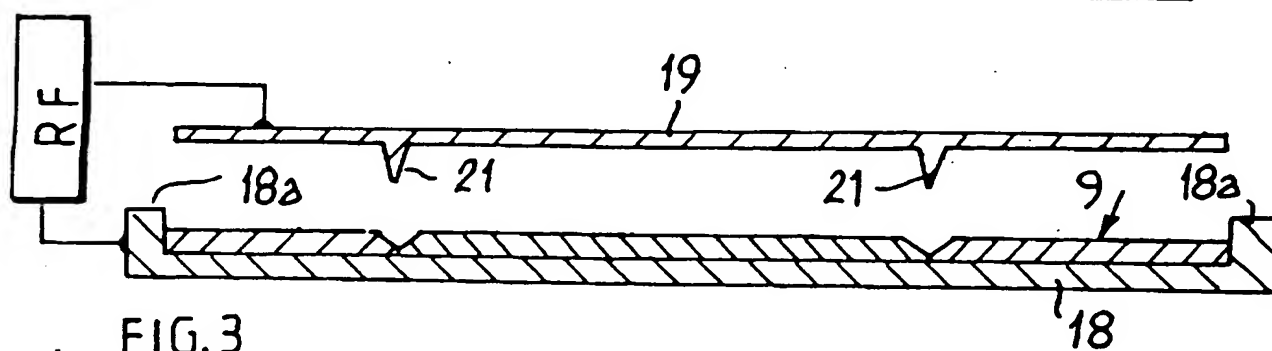


FIG. 3

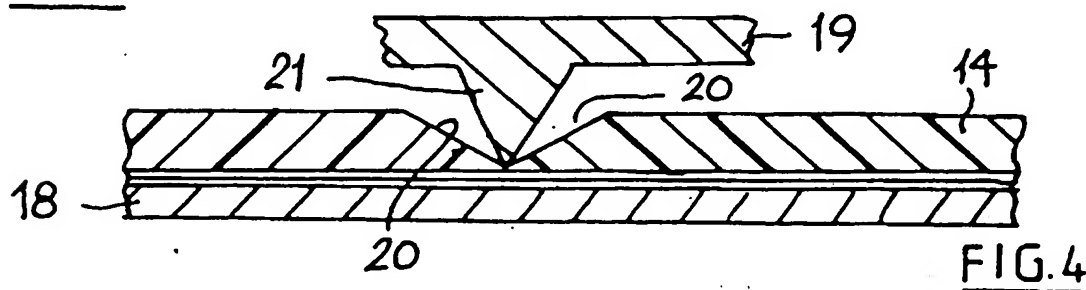


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 92/02361

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E04F 15/10, B29C 65/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B29C, B44C, E04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## WPI, CLAIMS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim N
A	US, A, 4828896 (L. FANTI), 9 May 1989 (09.05.89), column 2, line 1 - line 18, claims 1-6  --	1-6
A	US, A, 3647587 (J.C. MACDONALD), 7 March 1972 (07.03.72); column 1, line 45 - line 50; column 2, line 50 - line 55, claim 1  -----	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

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\*Y\* document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

\*&amp;\* document member of the same patent family

Date of the actual completion of the international search

19 March 1993

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

26/02/93

International application No.  
PCT/GB 92/02361

Patent document cited in search report		Publication date	Patent family member(s)	Publication date	
US-A-	4828896	09/05/89	EP-A-	0273597	06/07/88
			GB-A,B-	2198165	08/06/88
			JP-A-	63149137	21/06/88
-----					
US-A-	3647587	07/03/72	NONE		
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